Emerging high throughput analyses of cyanobacterial toxins and toxic cyanobacteria

Kaarina Sivonen

Department of Applied Chemistry and Microbiology, P.O.Box 56, Viikki Biocenter, FI-00014 Helsinki University, Finland, e-mail: kaarina.sivonen@helsinki.fi

Cyanobacterial mass occurrences (blooms) are found in fresh and brackish waters, oceans as well as benthic environments. Various cyanobacteria produce wide variety of toxins. To protect water uses from poisoning and exposure to the toxins, it is important to know the identity and quantity of the toxins e.g. drinking water, dietary supplements, important areas for recreation, animal-poisoning cases etc. The structures of the most widespread toxins are known and that has made possible to develop high throughput analysis methods such as ELISA and LC/MS. ELISA is available for cyanobacteria hepatotoxins and saxitoxins. LC/MS is excellent method to identify the individual toxins. Improvement of the instruments has also made the method very sensitive. The time limiting step still is sampling and sample preparation/extraction. Availability of standards of certain toxins causes problems.

In order to apply any rational mitigation scheme we should learn more about the toxin producer organisms including their biology, ecology and proliferation. The major toxin producers have been identified by isolating the organisms and showing their toxin production capacity. Such culture collections have been valuable sources for taxonomic/phylogenetic analyses of toxin producers as well as studies on the biosynthesis of toxins. We cannot identify toxin producers by microscopy since toxic and non-toxic strains of the same species are known to occur. The gene clusters involved in microcystin and nodularin production are known. This has made possible to develop methods to identify these toxin producers in the samples. Conventional PCR is a fast method to detect potentially toxin-producing strains in the samples. The real time–PCR will, in addition, yield quantitative information and answer the question which organism is a major producer of the toxins in a sample. DNA chips offer new insight into cyanobacterial populations. It can identify all cyanobacteria that are present in a sample and pinpoint the toxin producers providing that probes for these groups have been designed. Example of a development of microarray in an EU-project MIDI-CHIP will be presented. The DNA – chip technology offers attractive monitoring system for toxic cyanobacteria. Only with these new technologies (PCR + DNA-chips) we will be able to study toxic cyanobacteria populations *in situ* and study the environmental factors affecting especially the occurrence of toxic cyanobacteria. In addition, the on-going genome projects of toxin producing cyanobacteria will yield a wealth of information on the biology and metabolic regulation of these organisms in near future.